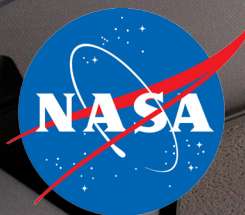


National Aeronautics and Space Administration



GoddardView

Volume 5 Issue 8

Climate Simulation Computer Becomes Even More Powerful

Pg 4

**Space Technology Could Help Early Detection
of Breast Cancer**

Pg 7

An Open Letter to the *Hubble* Team

Pg 12

www.nasa.gov

System Engineering Leadership Development Program Graduates

By Matthew Kohut

Fifteen systems engineers from across NASA graduated from the first class of the Systems Engineering Leadership Development Program (SELDP) in June 2009.

The program's graduation week featured presentations by each participant to the NASA Engineering Management Board, talks by systems engineering experts from government and industry, and a "leadership lessons" tour of the Gettysburg battlefield with an instructor from the Army War College.

The graduation week marked the culmination of a yearlong program that provided participants with knowledge, skills, and experiences aimed at preparing them for the challenges of systems engineering leadership at NASA. After a rigorous application process, the program kicked off in the spring of 2008. Once participants completed baseline assessments to identify strengths and areas for development, they embarked on a year of learning, developing, and practicing the qualities of a systems engineering leader: creativity, curiosity, self-confidence, persistence, and an understanding of human dynamics. Program activities included mentoring and coaching, technical training, leadership development exercises, and forums.

The core of the SELDP experience was a hands-on developmental assignment at a new Center. Participants took on systems engineering roles that expanded their experience base and challenged them to incorporate new knowledge and skills in an unfamiliar organizational setting. Angela Russo, from Goddard's Systems Engineering Branch, was assigned to Langley Research Center, where she served as a systems engineer on the Orion Launch Abort System in support of Pad Abort-1 and Ascent Abort-1 flight tests. Scott Glubke, Goddard's Propulsions Branch Head, was assigned to Kennedy Space Center, where he served as an Integration Project Engineer in the NASA Launch Vehicle Processing Directorate, Project Engineering Integration Division.

SELDP grew out of a need identified by NASA leadership and the Office of the Chief Engineer for an Agency-wide leadership development program that would help identify and accelerate the development of high-potential system engineers, with a focus on specific leadership behaviors and technical capabilities that are critical to success in the NASA context. Headed by Christine Williams of the NASA Academy of Program/Project and Engineering Leadership (APPEL), SELDP aims to develop and improve leadership skills and technical capabilities. ■



Caption: Featured in the picture from left to right are then-Acting NASA Administrator Chris Scolese, Carolyn Casey, Scott Glubke, Angela Russo, Orlando Figueroa, and Chief Engineer Michael Ryschkewitsch.

Photo credit: NASA

GoddardView

Volume 5 Issue 8

Table of Contents

Goddard Updates

System Engineering Leadership Development Program Graduates – 2

NASA Television Receives Philo T. Farnsworth Primetime Emmy Award – 3

Climate Simulation Computer Becomes Even More Powerful – 4

Goddard's New Exploration Sciences Building: Secrets Unveiled on Unique Features – 5

NASA Researchers Make First Discovery of Life's Building Block in Comet – 6

Space Technology Could Help Early Detection of Breast Cancer – 7

Tracking and Data Relay Satellite Mission Passes Major Review – 8

First Chesapeake Bay-Focused Environmental Management System Training Hosted at Goddard – 9

Honey Bees Turned Data Collectors Help Scientists Understand Climate Change – 10

Goddard Family

An Open Letter to the *Hubble* Team – 12

Cover caption: Goddard recently added 4,128 processors to its Discover High-End Computing System, with another 4,128 processors to follow this fall. The expanded Discover will host NASA's climate simulations for the Intergovernmental Panel on Climate Change.

Photo Credit: Pat Izzo

GoddardView Info

Goddard View is an official publication of the Goddard Space Flight Center. It is published bi-weekly by the Office of Public Affairs in the interest of Goddard employees, contractors, and retirees. A PDF version is available online at:

<http://www.nasa.gov/centers/goddard/news/index.html>

Managing Editor: Trusilla Steele

Editor: John Putman

Deadlines: News items for publication in the Goddard View must be received by noon of the 2nd and 4th Tuesday of the month. You may submit contributions to the editor via e-mail at john.m.putman@nasa.gov. Ideas for new stories are welcome but will be published as space allows. All submissions are subject to editing.

NASA Television Receives Philo T. Farnsworth Primetime Emmy Award

By Bob Jacobs

NASA Television has been honored with a Primetime Emmy Award by the Academy of Television Arts & Sciences. The 2009 Philo T. Farnsworth Award recognizes the Agency for engineering excellence and commemorates the 40th anniversary of the technological innovations that made possible the first live TV broadcast from the Moon by the *Apollo 11* crew on July 20, 1969.

The prestigious Emmy Award, named after the man credited with designing and building the world's first working television system, honors an agency, company, or institution with contributions over a long period of time that have significantly affected television technology and engineering.



Caption: The 2009 Philo T. Farnsworth Primetime Emmy Award given to NASA Television in recognition for engineering excellence and technological innovations that made possible the first live TV broadcast from the Moon by Apollo 11.

"I congratulate the many NASA staffers who are being recognized by the Academy with this award for contributions to television engineering excellence," NASA Administrator Charles Bolden said. "From the first landing of man on the Moon in 1969 to today's high definition broadcasts of America's ongoing space exploration initiatives, television has been a powerful communications tool that enables the Agency to share its achievements in exploration and discovery with the world."

In 1927, Farnsworth was the first inventor to transmit a television image comprised of 60 horizontal lines. He developed the dissector tube, the foundation of the modern electronic televisions. In a 1996 interview, his wife Elma, whose nickname was Pem, said the two of them watched the televised *Apollo 11* Moonwalk with pride. "We were watching it and when Neil Armstrong landed on the Moon Phil turned to me and said, 'Pem, this has made it all worthwhile.' Before then, he wasn't too sure."

"I am honored to have been selected to accept this award on behalf of NASA and the hundreds of engineers and technicians who made the telecast of this historic event possible," said Richard Nafzger, an engineer at Goddard. Nafzger was 28 years old when he worked with the team that brought television from the Moon to a worldwide audience estimated at more than 600 million people.

Joining Nafzger in accepting the honor was *Apollo 11* Lunar Module Pilot and Moonwalker Buzz Aldrin.



Caption: Actress June Lockhart, center, stands with Goddard Engineer Richard Nafzger, left, and Apollo 11 astronaut Buzz Aldrin, right, after the men accepted the 61st Primetime Emmy Engineering Award.

Today, NASA TV is available on four digital channels, serving the general public, educators, and journalists. It also is streamed continuously over the Agency's Internet homepage.

The Primetime Emmys are awarded by the Academy of Television Arts & Sciences in North Hollywood, Calif. Recipients of the Engineering Awards received their statues during a special ceremony on Saturday, August 22, at the Renaissance Hotel in Los Angeles.

This is NASA Television's second Emmy Award for 2009. In January, the Midsouth Chapter of the National Television Academy awarded NASA TV the Governor's Award for Lifetime Achievement at a ceremony in Nashville, Tenn. ■

Photo credit: Bill Ingalls

Photo credit: Matthew Imaging/ATAS

Climate Simulation Computer Becomes Even More Powerful

By Jarrett Cohen, Sarah DeWitt, and Lori Keesey

Remember the day you got a brand-new computer? Applications snapped open, processes that once took minutes finished in seconds, and graphics and animation flowed as smoothly as TV video. But several months and many new applications later, the bloom fell off the rose.

Your lightning-fast computer no longer was fast. You needed more memory and faster processors to handle the gigabytes of new files now embedded in your machine.

Climate scientists can relate.

They, too, need more powerful computers to process the sophisticated computer models used in climate forecasts. Such an expanded capability is now being developed at NASA's Goddard Space Flight Center.

High-End Computing System Installed

In August, Goddard added 4,128 new-generation Intel "Nehalem" processors to its Discover High-End Computing system. The upgraded Discover will serve as the centerpiece of a new climate simulation capability at Goddard. Discover will host NASA's modeling contributions to the Intergovernmental Panel on Climate Change (IPCC), the leading scientific organization for assessing climate change, and other national and international climate initiatives.

To further enhance Discover's capabilities, Goddard will install another 4,128 Nehalem processors in the fall, bringing Discover to 15,160 processors. "We are the first high-end computing site in the United States to install Nehalem processors dedicated to climate research," said Phil Webster, Chief of Goddard's Computational and Information Sciences and Technology Office (CISTO). "This new computing system represents a dramatic step forward in performance for climate simulations."

Well-Suited for Climate Studies

According to CISTO lead architect Dan Duffy, the Nehalem architecture is especially well-suited to climate studies. "Speed is an inherent advantage for solving complex problems, but climate models also require large memory and fast access to memory," he said. Each processor has 3 gigabytes of memory, among the highest available today. In addition, memory access is three to four times faster than Discover's previous-generation processors.

In preliminary testing of Discover's Nehalem processors, NASA climate simulations performed up to twice as fast per processor compared with other nationally recognized high-end computing systems. The new computational capabilities also allowed NASA climate scientists to run high-resolution simulations that reproduced atmospheric features not previously seen in their models.

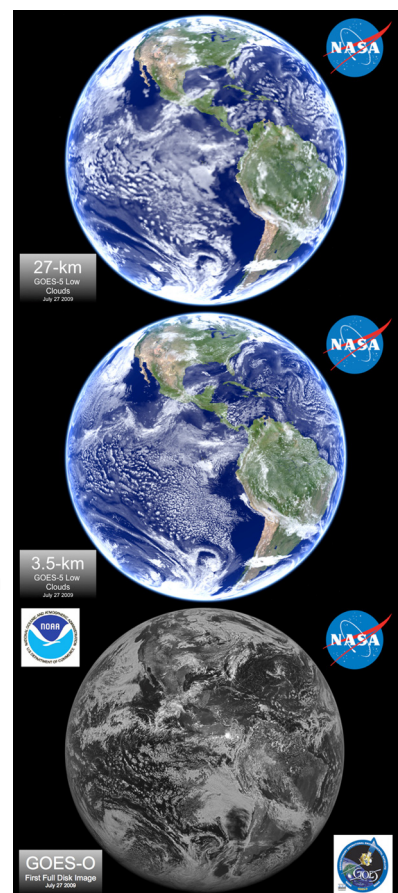
For instance, "Features such as well-defined hurricane eyewalls and convective cloud clusters appeared for the first time," said William Putman, acting lead of the Advanced Software Technology Group in Goddard's Software Integration and Visualization Office. "At these cloud-permitting resolutions, the differences are stunning."

IPCC Simulations

For the IPCC studies, scientists will run both longer-term and shorter-term climate projections using different computer models. A climate model from the Goddard Institute for Space Studies will perform simulations going back a full millennium and forward to 2100. Goddard's Global Modeling and Assimilation Office will use a climate model for projections of the next 30 years and an atmospheric chemistry-climate model for short-term simulations of chemistry-climate feedbacks. The IPCC will use information from climate simulations such as these in its Fifth Assessment Report, which IPCC expects to publish in 2014.

NASA climate simulation efforts also contribute to the U.S. Global Change Research Program, the U.S. Integrated Earth Observation System, and the U.S. Weather Research Program. Supported international programs include the United Nations Educational, Scientific, and Cultural Organization's Intergovernmental Oceanographic Commission; the United Nations Environment Programme; the World Climate Research Programme; the World Meteorological Organization; and the World Weather Research Programme.

For more information on NASA's High End Computing Program, visit: <http://www.hec.nasa.gov>. More information on the Discover High End Computer System can be found at: http://www.nccs.nasa.gov/discover_front.html. To learn more about Goddard's Global Modeling and Assimilation Office, visit: <http://gmao.gsfc.nasa.gov>. For more information on Goddard's Software Integration and Visualization Office, visit: <http://sivo.gsfc.nasa.gov>. ■



Caption: New high-resolution climate simulations reproduce atmospheric features not previously seen in NASA computer models. Moving from 27-kilometer resolution (top) to 3.5-kilometer resolution (center) yields cloud clusters like those seen in observations from NOAA's latest GOES satellite (bottom).

Photo credit: NASA/NOAA

Goddard's New Exploration Sciences Building: Secrets Unveiled on Unique Features

By Rob Gutro

Goddard's Exploration Sciences Building (ESB) may appear to be just another office building, but there are a lot of secrets inside that make it the most special building on the Goddard campus. This is the first in a series of articles that will uncover some of those secrets in what will be numbered Building 34.

One of the purposes in the design of the ESB is to foster collaboration among scientists that work in the building. So, the building was designed to give people a way to "run into each other." One such feature is a collaboration area located at the center of the building on each of the three floors. The design concept was centered on the idea of encouraging scientists to cross paths and engage one another towards the next new exciting discovery. Sharing ideas is how science happens. The collaboration area will serve as a way to unite the office and lab portions of the building near the centralized staircase.



Photo credit: Debora McCallum

Caption: Collaboration area at the foot of the centralized staircase on the first floor. One of these collaboration areas in the center of the building appear on all three floors.

Another feature that allows for more interaction is a "conference hallway" located on the first floor. The building provides for a common location for both medium and large conference rooms along with an oversized "symposium room" capable of seating 200 persons. The hallway intersects the building lobby, which is adjacent to the café with outdoor seating, central elevators, display areas, restrooms, and telephone. Combining food and conference space in a pleasing environment help to set the table for solid interaction and dialogue.



Photo credit: Debora McCallum

Caption: Large conference room along the "conference hallway" on the first floor.

Other secret gems include a large skylight at the centralized staircase allowing natural light to spill throughout the top two floors of the collaboration area. To assist with easy navigation throughout the building, each floor is uniquely color coded. This will make finding one's way easier for building occupants and visitors.



Photo credit: Debora McCallum

Caption: Skylight at the top of the central stairs.

The building is designed with standard 150 square foot offices along the perimeter of the building. Near the east and west ends of the center of each floor of the building there are copy rooms, small conference rooms, Branch offices, and restrooms. The Division suites are located on the east end of the 1st and 2nd floors and the Directorate office suite is located on the west end of the 3rd floor. ■

NASA Researchers Make First Discovery of Life's Building Block in Comet

By Bill Steigerwald

NASA scientists have discovered glycine, a fundamental building block of life, in samples of comet Wild 2 returned by NASA's *Stardust* spacecraft.

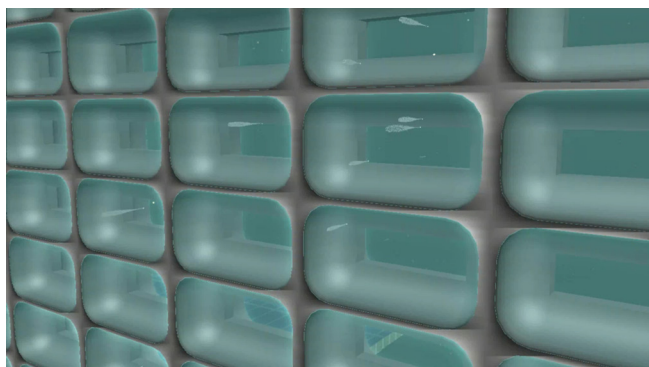
"Glycine is an amino acid used by living organisms to make proteins, and this is the first time an amino acid has been found in a comet," said Dr. Jamie Elsila of Goddard. "Our discovery supports the theory that some of life's ingredients formed in space and were delivered to Earth long ago by meteorite and comet impacts."

Elsila is the lead author of a paper on this research accepted for publication in the journal *Meteoritics and Planetary Science*. The research was presented during the meeting of the American Chemical Society in Washington, D.C. on August 16.

"The discovery of glycine in a comet supports the idea that the fundamental building blocks of life are prevalent in space, and strengthens the argument that life in the universe may be common rather than rare," said Dr. Carl Pilcher, Director of the NASA Astrobiology Institute, which co-funded the research.

Proteins are the workhorse molecules of life, used in everything from structures like hair to enzymes, the catalysts that speed up or regulate chemical reactions. Just as the 26 letters of the alphabet are arranged in limitless combinations to make words, life uses 20 different amino acids in a huge variety of arrangements to build millions of different proteins.

Stardust passed through dense gas and dust surrounding the icy nucleus of Wild 2 (pronounced "Vilt-2") on January 2, 2004. As the spacecraft flew through this material, a collection grid filled with aerogel—a sponge-like material that's more than 99 percent empty space—gently captured samples of the comet's gas and dust. The grid was stowed in a capsule that detached from the spacecraft and parachuted to Earth on January 15, 2006. Since then, scientists around the world have been busy analyzing the samples to learn the secrets of comet formation and our solar system's history.



Caption: Artist's concept of particle hits on the aerogel collection grid. The greenish areas represent the aerogel. Hits are the light green teardrop-shaped areas. Particles are represented by dots at the tips of the teardrops.

"We actually analyzed aluminum foil from the sides of tiny chambers that hold the aerogel in the collection grid," said Elsila. "As gas molecules passed through the aerogel, some stuck to the foil. We spent two years testing and developing our equipment to make it accurate and sensitive enough to analyze such incredibly tiny samples."

Earlier, preliminary analysis in Goddard labs detected glycine in both the foil and a sample of the aerogel. However, since glycine is used by terrestrial life, at first the team was unable to rule out contamination from sources on Earth. "It was possible that the glycine we found originated from handling or manufacture of the *Stardust* spacecraft itself," said Elsila. The new research used isotopic analysis of the foil to rule out that possibility.

Isotopes are versions of an element with different weights or masses. For example, the most common carbon atom, Carbon 12, has six protons and six neutrons in its center (nucleus). The Carbon 13 isotope, however, is heavier because it has an extra neutron in its nucleus. A glycine molecule from space will tend to have more of the heavier Carbon 13 atoms in it than glycine that's from Earth. That is what the team found. "We discovered that the *Stardust*-returned glycine has an extraterrestrial carbon isotope signature, indicating that it originated on the comet," said Elsila.

The team includes Dr. Daniel Glavin and Dr. Jason Dworkin of Goddard. "Based on the foil and aerogel results, it is highly probable that the entire comet-exposed side of the *Stardust* sample collection grid is coated with glycine that formed in space," adds Glavin.

"The discovery of amino acids in the returned comet sample is very exciting and profound," said *Stardust* Principal Investigator Professor Donald E. Brownlee of the University of Washington, Seattle, Wash. "It is also a remarkable triumph that highlights the advancing capabilities of laboratory studies of primitive extraterrestrial materials."

The research was funded by the NASA Stardust Sample Analysis program and the NASA Astrobiology Institute. NASA's Jet Propulsion Laboratory, Pasadena, Calif., manages the *Stardust* mission for NASA's Science Mission Directorate. Lockheed Martin Space Systems developed and operated the spacecraft.

To learn more about the mission, visit: <http://stardustnext.jpl.nasa.gov>.

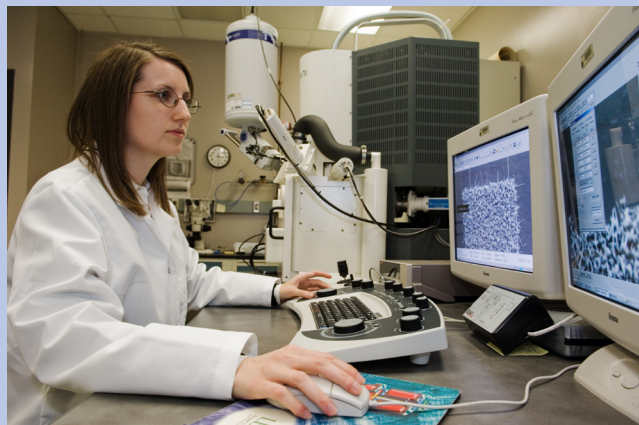
For more about the Goddard astrobiology team, visit: <http://astrobiology.gsfc.nasa.gov/analytical>. ■

Space Technology Could Help Early Detection of Breast Cancer

By Lori Keesey

Using the same instrument to detect life on Mars and cancer lurking inside the human body isn't as far-fetched as one might think. Just ask Goddard technologist Stephanie Getty. She is now developing a technology platform that might be able to do both.

Under a grant with the National Institutes of Health (NIH), Getty is collaborating with the University of Maryland, Catholic University, and the National Cancer Institute (NCI) to develop a nano-scale detector that would locate specific biomarkers linked to breast cancer. The hope is that the NanoBio-Sensor Initiative will result in an instrument that physicians could use in a clinical setting to detect the presence of cancer biomarkers or predict the prognosis of a patient developing the disease.



Caption: Stephanie Getty at work in the lab.

Getty, who joined the Center nearly five years ago to pursue nano-technologies for spaceflight applications, also is receiving Goddard Internal Research and Development funding to advance her instrument concept. The same detector technology, which she calls ChemFET, could be used to detect organic molecules that may indicate the presence of past or current life on Mars, Titan, and other solar system bodies.

NASA also might be able to use a modified version of the technology to detect specific genetic sequences to assure that terrestrial organisms have not contaminated samples collected on Mars or the Moon or to screen astronauts for cancer due to over-exposure to the Sun's harmful radiation during long-term stays on the Moon. "This is a unique opportunity to leverage funding," Getty said. "It really is a dual-use technology."

But even Getty concedes that due to the long-range nature of NASA's exploration initiatives, it may take years before her instrument concept actually flies in space. That's why she pursued other funding avenues to help advance her ChemFET platform, she said.

Winning an NIH grant to help fund her work, Getty said, was fortuitous, a matter of being in the right place at the right time. "Actually, I was trying to find clean room space," Getty explained, when she met Robert Rashford, a systems engineer with the *James Webb Space Telescope*.

During a conversation with Rashford, she discovered that he knew an NCI researcher who was interested in developing a miniaturized diagnostic tool that would replace an existing approach called DNA microarray technology, which allows scientists to examine thousands of genes at a time to study patterns of activity in cells.

Some people have a greater chance of developing certain types of cancer if a mutation occurs in specific genes. The presence of such a change is sometimes called a risk marker, indicating that cancer is more likely to occur. Tumor markers, on the other hand, are substances produced by tumor cells and are found in blood, urine, and tumor tissue. To date, researchers have identified more than a dozen substances that express abnormally when some types of cancer are present. Breast cancer is one.

Although DNA microarray technology is a powerful tool for identifying the presence of these biomarkers, the technique is currently confined to research laboratories due to time-consuming sample preparation, intensive data analysis, and cost, Getty said. ChemFET, however, offers a viable solution to the cancer-detection challenge because it uses nano-components and a fully electronic detection method. Both are compatible with miniaturization and rapid data analysis.

"We have proved the concept," she said. "Now we need to make it easy for a company to manufacture it. The point is we want to create a tool so that anyone could come into a clinic to be tested for breast cancer more rapidly." ■

Tracking and Data Relay Satellite Mission Passes Major Review

By Susan Hendrix

NASA's goal of providing outstanding communications support for the *International Space Station (ISS)*, *Hubble Space Telescope*, and a myriad of other unmanned spacecraft in low Earth orbit moved one step closer last month when Agency officials gave a thumbs-up to critical elements for the next generation of *Tracking and Data Relay Satellites (TDRS)*.



Image credit: Boeing

Caption: An artist's conception of TDRS K/L.

Then acting NASA Administrator Christopher Scolese chaired the Program Management Council meeting, which thoroughly reviewed the TDRS K/L program readiness. With a successful review on the books, the team can move ahead with the implementation phase of their mission.

"Achieving this key milestone means we can now focus on building these additional TDRS, which are critical to providing communications support for NASA's missions," said Jeff Gramling, TDRS Project Manager at Goddard.

The TDRSs are the orbiting spacecraft component of a larger Tracking and Data Relay Satellite System, or TDRSS. Also referred to as the NASA Space Network, TDRSS consists of several on-orbit telecommunications satellites stationed in geosynchronous orbit above Earth, along with associated ground stations at White Sands, N.M., and on Guam. Telemetry and high-rate mission data from various spacecraft are down-linked via the *Tracking and Data Relay Satellites* to the ground segment and then onto the designated control centers or data collection points.

"Without a robust TDRS fleet, science data and high-def video from the Shuttle and ISS wouldn't be possible," said Space Network Project Manager Roger Flaherty at Goddard.

The next milestone for the TDRS program occurs in January 2010, when the team participates in a critical design review, which will examine detailed aspects of the spacecraft, overall system, and mission design. According to Gramling, once they pass this milestone, the team can begin assembling the spacecraft and its associated communications payload.

Established in 1973, the TDRS project is responsible for developing, launching, and on-orbit testing and calibration of each new TDRS spacecraft. There have been four separate contracts for these spacecraft: the Basic Program, which includes TDRS 1-6, the Replacement Program—TDRS 7—which was a replacement for the satellite lost in the *Challenger* accident, and TDRS 8-10. The latest is the TDRS K/L Program, consisting of two satellites that will be renamed 11 and 12 after on-orbit checkout and acceptance.

TRW (now known as Northrop Grumman of Redondo Beach, Calif.) built the first seven TDRS. Boeing Space Intelligence Systems of El Segundo, Calif., formally known as Hughes Space and Communications Company, built TDRS 8-10 and won a bid to build the K/L series. The contract has options for two additional spacecraft—TDRS M and N.

Goddard manages the TDRS program on behalf of NASA's Space Communications and Navigation (SCaN) Program Office in Washington, D.C. For more information about the *Tracking and Data Relay Satellite* project, visit: <http://nssdc.gsfc.nasa.gov/multi/tdrs.html>. ■

First Chesapeake Bay-Focused Environmental Management System Training Hosted at Goddard

By Lixa Ramon

On August 4–5, the Safety, Health, and Environmental Division, Code 250, hosted the first Chesapeake Bay-focused Environmental Management System (EMS) training for the Environmental Protection Agency (EPA), Region III. The workshop's purpose was to educate attendees about using EMS as a management tool to reduce and eliminate impacts to the Chesapeake Bay.

Goddard Center Director Robert Strain welcomed participants and Tom Paprocki, Director of the Management Operations Directorate, provided an overview of Goddard's EMS. Jim Edward, EPA Region III Chesapeake Bay Program Deputy Director, provided information about the Bay and the first Executive Order signed by the new administration: Executive Order 13508—Chesapeake Bay Protection and Restoration. Sixteen speakers addressed more than 50 representatives from Federal Agencies such as the Department of Defense, the Department of the Interior, the Department of Agriculture, the Federal Bureau of Investigation, and others.



Photo credit: Michael Hooks

Caption: Attendees from many Federal Agencies learn from one of many Environment Management System training presentations.

Training presentations included such topics as Goddard's greenhouse gas inventory, storm water management, low impact development, and EMS implementation. Judy Bruner, Goddard's EMS Management Representative, closed the workshop with remarks about the importance of implementing an EMS and how it has helped Goddard manage its environmental risks. The training was a success, and many attendees remarked that it increased their knowledge about the Chesapeake Bay and EMS.

On the final day of training, participants were offered a choice between two tours. One group visited the Integration and Testing Complex in Buildings 7/10/15/29. The tour was led by Carmine Mattiello, Assistant Head of the Environmental Test Engineering and Integration Branch, who did an excellent job explaining the work done at the facilities.



Photo credit: Pat Izzo

Caption: Training attendees tour the Building 7/10/15/29 complex and learned about some of the missions operated and managed by Goddard.

Lori Levine of the Safety, Health, and Environmental Division led the second group on a tour of Goddard's storm water management features. Attendees had the opportunity to see Goddard's recently created rain garden between Building 26 and the Goddard Child Development Center (Building 90), as well as a bioretention area at Building 32. The group was also briefed on *Earth Observing System* flight operations and data systems in Building 32, followed by a demonstration of the Moderate Resolution Imaging Spectroradiometer (MODIS) Rapid Response System.

At the end of the tours, all participants met at the Visitor Center for a Science on a Sphere presentation. Tour participants were impressed with the work done at Goddard and enjoyed the opportunity to visit and tour the Center.

The EPA Region III coordinator is studying the possibility of having this informative training at Goddard again in fall 2010. ■

Honey Bees Turned Data Collectors Help Scientists Understand Climate Change

By Adam Voiland

Estimates are that there are somewhere between 6 and 10 million species of insects on the planet, yet few are as charismatic as the honey bee.

Part of an order of winged insects called *Hymenoptera*, honey bees are best known for being prodigious producers of honey, the sweet amber substance they produce by partially digesting and repeatedly regurgitating the sugar-rich nectar found within the petals of flowering plants. They're also the workhorses of the modern industrial agricultural system, relied upon to pollinate crops ranging from almonds to watermelons to peaches. They're even noted dancers, capable of performing an array of complex "waggle" dances to communicate.

And now, thanks to an innovative project conceived by Wayne Esaias, a veteran oceanographer at Goddard, bees have yet another role: that of climate data collectors.

When honey bees search for honey, colony scouts tend to scour far and wide and sample the area around a hive remarkably evenly, regardless of the size of the hive. And that, Esaias explained, means they excel in keeping tabs on the dynamics of flowering ecosystems in ways that even a small army of graduate students cannot.

The key piece of data bees collect relates to the nectar flow, which in the mid-Atlantic region tends to come in a burst in the spring. Major nectar flows, typically caused by blooms of tulip poplar and black locust trees, leave an unmistakable fingerprint on beehives—a rapid increase in hive weight sometimes exceeding 20 pounds per day. When a nectar flow finishes, the opposite is true: hives start to lose weight, sometimes by as much as a pound a day.



Caption: Wayne Esaias, a NASA scientist, records the weight data of one of his beehives.

By creating a burgeoning network of citizen scientists who use industrial-sized scales to weigh their hives each day—HoneyBeeNet—Esaias aims to quantify the dynamics of nectar flow over time. Participating beekeepers send their data to Esaias who analyzes it, and posts nectar flow trend graphs and other environmental data for each collection site on HoneyBeeNet's Web site.



Caption: A beehive in West Friendship, Md., sits atop a scale. Once a day, the hive's owner, a backyard beekeeper, measures the hive's weight, which increases significantly during nectar flows in the spring.

The size of HoneyBeeNet, which relies almost entirely on small-scale backyard beekeepers, has doubled over the last year and now includes more than 87 data collection sites. While the majority of sites are in Maryland, HoneyBeeNet now has sites in more than 20 states.

Data from the network, when combined with additional data that reach back to the 1920s, indicate that the timing of spring nectar flows have undergone extraordinary changes. "Each year, the nectar flow comes about a half-day earlier on average," said Esaias. "In total, since the 1970s, it has moved forward by about month in Maryland."

Esaias and Goddard colleague Robert Wolfe recently compared nectar flow data from HoneyBeeNet to satellite data that measures the annual "green up" of vegetation in the spring, one of the first times that scientists have attempted such a comparison. They corresponded nearly perfectly, confirming the usefulness of the citizen science-derived data from HoneyBeeNet to address changes in nectar flows.

What's to blame for the warming trend in Maryland? Washington D.C.'s growth has certainly played a role. Urban areas, explained Esaias, produce a "heat island" effect that causes temperatures in surrounding areas to creep upward. In addition, Esaias suspects that climate change is also contributing.

[Continued on Page 11](#)

Honey Bees Turned Data Collectors Help Scientists Understand Climate Change

Continued from Page 10

That has him nervous. "A month is a long time. If this keeps up, and the nectar flows continue to come earlier and earlier, there's a risk that pollinators could end up out of sync with the plant species that they've pollinated historically," Esaias said.

He's not the only researcher who's looking at this issue. The National Academies of Science published a landmark report in 2007 that highlighted the precarious status of pollinators in North America.

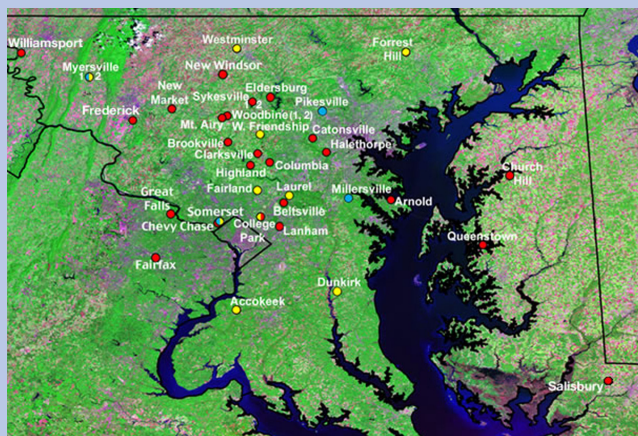
Many pollinators—ranging from honey bees, to bumble bees, to lesser known species—seem to be in the midst of protracted population declines. Managed honey bee colonies, for example, have seen their numbers fall from about 5.9 million in 1947 to just 2.4 million in 2005.

In most cases, it isn't clear what's causing the population declines or whether climate change is exacerbating the problem, though many researchers suspect that new types of viruses, mites, and other parasites and pesticides are important factors.

"But it's not just the honey bees that we need to be looking at," said May Berenbaum, an ecologist at the University of Illinois at Urbana-Champaign and the lead author on the National Academies report. "For honey bees, at least we can truck them around or feed them when there's a problem. It's the wild species of pollinators that are the greatest cause for concern."

Bumblebees, wasps, butterflies, and countless other insects, as well as some bats and birds, are the glue that keeps many wild ecosystems intact through pollination. And scientists are only beginning to comprehend the potential consequences that could unfold if the pollinators and the plants that rely on them get so far out of sync that extinctions begin to occur.

"To borrow an old analogy, losing a species is a bit like losing screws in a plane," said Berenbaum. "If you lose a few here or there, it's not the end of the world, and your plane can still fly. But if you lose too many, at some point, the whole plane can suddenly come apart in mid-flight."



Caption: The size of HoneyBeeNet, which relies almost entirely on small-scale backyard beekeepers, has doubled over the last year and now includes more than 87 data collection sites. The dots indicate HoneyBeeNet locations in Maryland and Virginia. Sites established since 2008 are yellow; those established between 1983 and 2008 are red, and those established before 1983 are blue.

Indeed, entomologists have hardly begun the task of identifying wild pollinators, not to mention determining definitely which species are threatened or how they might respond as the climate shifts. Esaias' research offers hints about how bees might respond to climate change. Still, scientists estimate that there are more than 30,000 different bee species alone, and only about half of them have been formally described.

Though just a proverbial drop in the honey bucket, HoneyBeeNet is one way that citizens can help scientists better understand how climate change is affecting one species of pollinator. Alice Parks, a backyard beekeeper from West Friendship, Md., has participated for two years. She bought a used scale for just \$26 at an auction, and weighs her hive every night.

"Weighing can be a chore sometimes," she said. "But it's such an incredibly rewarding project that it's worth it. I'm learning so much about my bees that's making me a better beekeeper, but I'm also contributing to a larger project that's helping scientists address environmental problems on a global scale."

For more information about HoneyBeeNet, visit:
<http://honeybeenet.gsfc.nasa.gov>. ■

An Open Letter to the *Hubble* Team

By Susan Hendrix

As Goddard's lead Public Affairs Specialist for Servicing Mission 4 to the *Hubble Space Telescope* (HST), I have had the privilege of working with several of the team's engineers and scientists.

With the *Hubble*'s final servicing mission now complete, many have told me they will need to find other positions, hopefully here on Center, or have plans to retire at the end of the year. I have read numerous heartfelt good-bye notes from engineers who are reluctant to leave the *Hubble* family. Many have worked most, if not all, of their career supporting *Hubble*'s five servicing missions. Below is one of those good-bye notes from Dan Lowry, one of many *Hubble* engineers.

"A few weeks ago, I accepted a position with *Earth Observing System* (EOS) Data and Operations System, EOS Mission Operations System, and EOS Real Time Processing System. I did this with great enthusiasm and for the new personal challenges, but also with much reluctance on leaving the *Hubble Space Telescope* project.

"I first joined the HST family formally in August 1988 as an electronics technician in the Ops Hardware Maintenance Team. I rose through the ranks and had the privilege to lead that team for several years. But my beginnings with *Hubble* started long before 1988.

"In 1980, I worked in the Kensington Engineers shop, a location that is now the Mission Operations Room. In 1981, I helped clear the remains of the previous project from the area that is currently the N85 Equipment Room—a computer room containing all of *Hubble*'s operational strings.

"In the past 21 years, I, like many of you, have come to think of *Hubble* as much more than a collection of well-designed components orbiting 350 miles above Earth. We speak of *Hubble* as a modern Christopher Columbus or sometimes like an unpredictable teenager. *Hubble* is a friend, and we are very proud to be associated with such a friend.



Photo provided by Dan Lowry

Caption: Former Hubble engineer Dan Lowry.

"I think of my HST coworkers as part of my extended family. Together, we have experienced highs—Servicing Mission 1, 2, 3A and 3B, and most recently 4—as well as extreme lows—delayed launch attempts caused by the Columbia disaster, the discovery of a flawed mirror, and Sean O'Keefe's decision not to fly Servicing Mission 4.

"I can never forget those with whom I have laughed and cried, sweated and nearly collapsed from exhaustion, planned and accomplished, and even bled on rare occasion. You will always be much more than former coworkers to me.

"And so it gives me great comfort in knowing that I leave the *Hubble* safely in your capable hands."

Dan will continue his career at Goddard, working for the *Earth Observing System* Project Science Office as a field engineer with the hardware team. I wish him and all the HST team members the best of luck in their new endeavors. ■